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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVI. NO. 1194. SATURDAY, MAY 16, 1942. 6D. PER COPY: POST FREE 8D.

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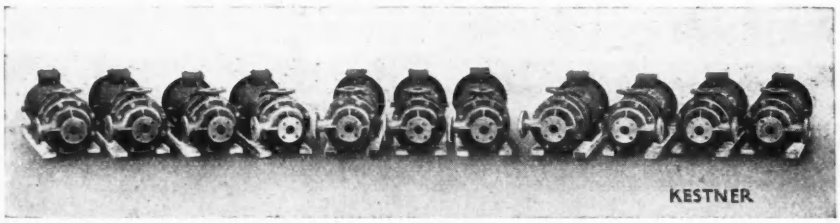

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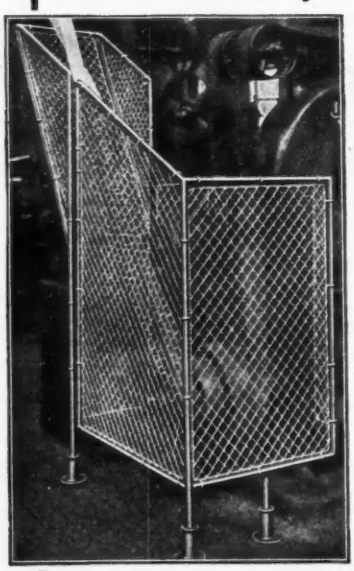

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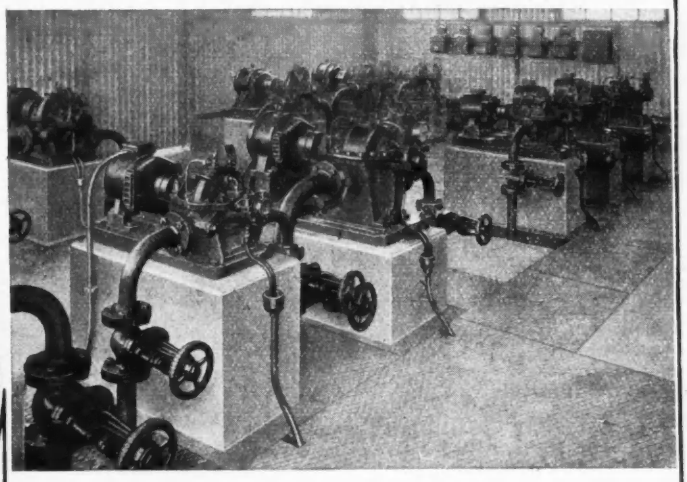

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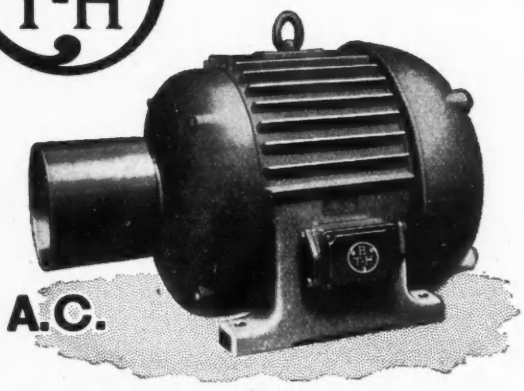

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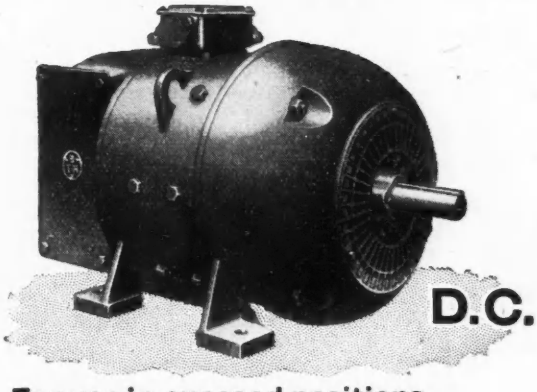

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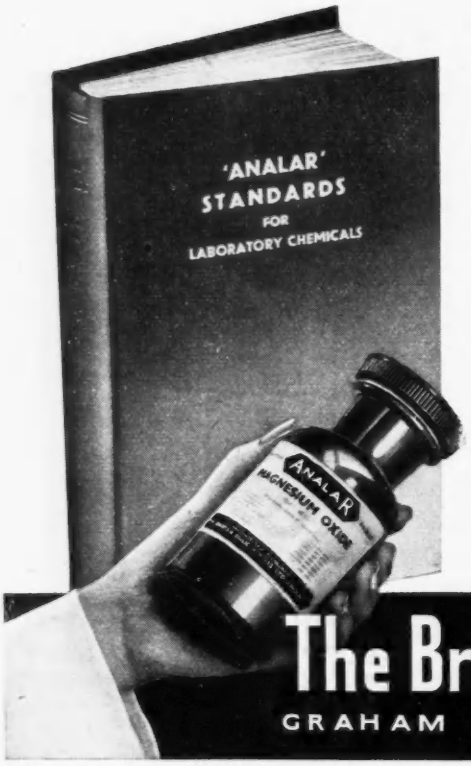

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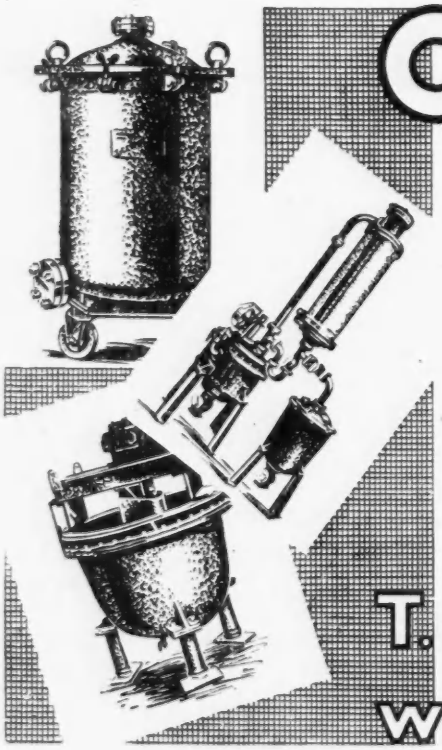

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VOL. XLVI. No. 1194 May 16, 1942

Annual Subscription, 21s.
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Statistical Control

TAKEN over the whole range of industry, the control of industrial processes is very variable. There are many processes in which virtually no control is exercised beyond the consumer's satisfaction with the final product. At the other end of this range there are processes in which every step is carefully watched and in which the least tendency to depart from a straight and narrow path is immediately checked. Between these limits lies the main body of industrial processes which produce the goods we need in peace or the munitions of war; these usually work within certain arbitrarily imposed limits of size and quality, in which the result of the process is frequently expressed as the percentage of rejects. It is evident that, where a material is produced by repetition work either continuously or in large batches, if the percentage of rejects can be reduced materially the output is increased and the cost of production decreased. What is even more important in war time is that the number of man-hours operated per unit of useful product is decreased.

The chemical industry is no stranger to scientific control and it is probably true to say that most chemical processes, including any processes in which a chemist has an active share, are rigorously controlled. Not only is the finished product analysed or otherwise tested on a regular basis, but daily and sometimes hourly samples are taken at various stages, not omitting the waste materials. Any disposition on the part of the process to yield a faulty product is thus checked before operations go so far wrong that an unsuitable end-product is obtained. Whether the new methods of statistical control will be applicable to the chemical industry depends on how far the fullest use is being made of the data collected. The importance of statistical control has been emphasised by a joint meeting of the principal Engineering Institutions of the country at which there was launched before a very large audience what virtually amounts to a proposal to introduce statistical control throughout the whole of British industry for all those processes to which it is suited.

The method in itself is not new. It has been operated at several large British works for some years, but it appears that certain individuals who were not acquainted with what has been done in this country have been so impressed by the use made of statistical control in American war production that they have convened this meeting in order to put it before their British colleagues. The American method has now been incorporated in a British Standard just published, and we recommend a study of this to those who desire to make use of the methods of statistical control without going deeply into the mathematics of the process. The underlying principle of the method lays down that in any machine or process there are unavoidable variations in the quality of the product due to inherent irregularities that cannot be avoided. It can be shown mathematically that if a certain number of samples is taken over a period the average value of these samples must fall within certain limits, known as the control limits, so long as the process is operating as satisfactorily as it is inherently capable of doing. If anything begins to go wrong with the process the average results of each group tend to deviate from this zone and will ultimately begin to fall more and more frequently outside the control limits which have been fixed on the theory of probability. The application of statistical control therefore enables the normal limits of functioning to be laid down scientifically on the basis of past records of performance; as soon as any tendency on the part of these results to attain wider limits becomes visible, it is obvious that something is at fault. By choosing the groups suitable the cause and the variation can be deduced more nearly than by the hit and miss methods frequently applied. A group may consist of records from a whole factory, from each shift of a factory, from a particular process in the factory, from a particular machine, and so forth. The narrower the limit taken for the group the more arduous is the work, because of the number of observations required, but the easier it is to put one's finger on the defect.

The ultimate and most important purpose of the control chart thus produced is therefore to provide an operational procedure for controlling quality in the manufacturing plant. Information regarding the state of control which is obtained by these charts may be desired by a manufacturer who wishes to obtain control of his own product, or by a purchaser who wishes to keep a check on the quality of the products supplied to him by a manufacturer.

From the point of view of the chemical industry the application of statistical control will probably lie primarily in testing how many samples are necessary from a given batch and in analysing the performance of a process on a sound mathematical basis. From this angle the works chemist becomes an inspector with in the meaning of the specification. If there is no quality control the inspector takes samples when he thinks necessary and uses the purchase specification tolerances to pass or reject. If quality control is practised the samples are taken regularly according to a definite plan, they are recorded, plotted, and analysed by the use of probability control limits. The charts should be exhibited prominently where operatives can see them, so that they act as continuous "stop-press" news of the process.

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NOTES AND COMMENTS

Exchange of Idle Plants

THE exchange of superfluous plant, tools, and materials between factories now devoted to war production has been widely and energetically counselled by the Ministry of Supply in this country, but few instances of this beneficent course of action have been made public, no doubt for "security" reasons. American industrialists are less bashful than ours, or perhaps their censorship is more broadminded, for a very useful and important exchange of the kind indicated has been recorded in a recent number of the A.C.S. *News Edition*. As soon as the United States entered the war, the Aluminium Company of America was faced with the immediate diversion of the major part of its aluminium production to the manufacture of aircraft. This resulted, among other things, in the temporary idleness of some cabling machinery designed to manufacture electric wire and cable. At the same time, the Anaconda Wire and Cable Co. found its facilities pushed to the utmost to supply the increased demand for electrical wires and cables of copper, especially cabling machinery. Competitive interests were shelved for the duration, and in the shortest possible time this cabling machinery was turned over to the Anaconda Wire and Cable Co. for a figure well below its original cost.

Stock Exchanges in War-time

THE popular but mistaken idea that all business enterprise should be "cut down" found another echo in the House of Commons on Thursday last week, when the Minister of Labour was asked "if he would have an investigation made into the large number of men employed on the Stock Exchanges," and "whether the continuance of these institutions was necessary in view of the needs of the country." Mr. Bevin replied in Parliamentary style that he had the matter under "active consideration," but a more informative answer was promptly given by the City Editor of *The Times*. After sympathising with the Minister's problem in reference to man-power, he pointed out that the pre-war personnel of the London Stock Exchange, amounting to about 14,000, had been reduced by November last to under 6000. Of the male staff remaining, only 280 were of military age, more than half being in the age group 38 to 41 As to whether Stock Exchanges are "necessary," the City Editor added that the existence of a free security market was never more in the best interests of the country than to-day. At a guess, at least a quarter of British Government loans are turned over every year, and if the ability to buy and sell such funds were denied this would have a most adverse effect on the national savings campaign in all its ramifications.

A Word for the "Small Man"

THE needs of the small business man in the post-war world are referred to in a report just issued by the Association of British Chambers of Commerce. This suggests that a council of industry should be set up by representatives of industry, commerce, and labour to advise the Government of the day, with the approval of Parliament, on what steps should be taken to facilitate the return to peace conditions. While recognising that the continuance of certain controls will be necessary for some time after the war, it is urged that in no case should the period of control be unnecessarily prolonged. "In de-concentration schemes," the report adds, "the small man's claim to re-establish himself should be given every encouragement in all branches of trade and industry, and some form of Government financial assistance provided, in order to rehabilitate businesses financially exhausted as a result of heavy taxation and expenditure of cash." To accept State aid will doubtless go against the grain with small traders, but since many have sacrificed their independence in the national interest, it is only just that the Government should help them to start again when peace returns.

British Chemical and Dyestuffs Traders' Association

Formation of Special Committees

THE 19th annual meeting of the members of the British Chemical and Dyestuffs Traders' Association, Ltd., was held at the Great Eastern Hotel, London, E.C.2, on May 13, Mr. A. F. Lawson (the chairman) presiding. In the course of his report, Mr. Lawson referred to the fact that 1941 had proved yet another period of progressive activity. The following are extracts from the report:—

Throughout the year the distribution of chemicals was well organised to meet the requirements of the essential consuming industries, and problems of supply, due to the scarcity of some products, were often surmounted by the resourcefulness of chemical traders in finding substitute materials. Frequent bulletins were issued, drawing the attention of members to matters of special interest and giving particulars of any relative Statutory Rules and Orders and Government directions. It is always the aim of the Association to bring about a proper understanding of the complexities of official administration on the one side and the problems confronting the trade on the other.

The increasing dependence on home sources of supply and the expansion in the demand for certain products has necessitated appropriate official action to ensure that available raw materials are used to the best advantage, and during the year a number of chemicals were covered by Control Orders, many of which will operate for a considerable time after the war. In many cases circumstances have permitted a voluntary arrangement between producer and distributor in which provision is made for the allocation of supplies to essential industries on a rationed basis.

There is no doubt that the contacts established have contributed to smooth working.

A representative Group for each of the main classes of chemicals was set up, and each Group appointed a Standing Committee to examine special questions. The proposal to fix maximum prices for cresylic acid was the subject of a number of discussions between the Coal-Tar Products Group and the Coal-Tar Controller with the result that provision has been made in the Coal-Tar Acids Prices Order for merchants handling cresylic acid. Because of the increasing importance of coal-tar products to the war industries provision has been made in the Coal-Tar Order for a wider form of control. The Standing Committee of the Group is giving active consideration to these matters.

At the request of the Ministry of Supply the Association has agreed to organise, as agents for the Minister, the distribution of a number of products imported into the United Kingdom on Lease-Lend terms. The scope of this work is at present limited to a range of pharmaceutical products, but if products of interest to other sections of the trade should come within the scheme, the appropriate Group will, of course, be consulted.

While export trade during 1941 was curtailed by the need to conserve supplies for home requirements, a fair amount of export business was permitted for approved destinations and essential materials.

In concluding the report, Mr. Lawson emphasised the importance of approaching mutual problems collectively within the Association and pointed out that problems of reconstruction after the war will be surmounted only by the closest co-operation in all industries.

The president, vice-president, chairman, vice-chairman, and hon. auditor were re-elected for a further year. Mr. C. W. Lovegrove was elected hon. treasurer, and Mr. E. F. J. Arnold (R. W. Greeff & Co.), Mr. W. Beckley (Chas. Zimmerman & Co.), and Mr. S. R. Price (Price, Stutfield & Co.), were elected as executive council.

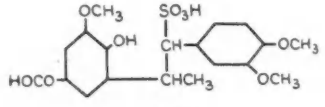
Developments in Lignin Chemistry, III

Sulphur-Lignin Reactions

(*Continued from* THE CHEMICAL AGE, *May* 9, 1942, *p.* 244)

IT is not yet clear what the importance of sulphide is when it is added to the alkali in the sulphate-cooking of wood. It is fairly certain that sulphate-cooking is mainly an alkali-cooking, but the lignin takes up sulphur, presumably in the form of $-SH-$ groups ("sulphur lignin"). This problem has recently been studied by Professor Hägglund at the Technical High School, Stockholm. Alcoholysis has also been used in the digestion process, employing many diverse alcohols. Not only methyl and ethyl, but also butyl alcohol, glycol, and benzyl alcohol have been used. There is general agreement that the alcohols enter into the lignin as alkoxy groups. With phenols the reaction seems to take a different course on account of the ease with which phenols undergo condensation, and the phenol enters into the lignin, not as a phenoxyl group, but through condensation. One may presume, however, that the same groups in the lignin are active as in the case of the alcoholyses (tertiary OH groups and ether-atoms of the benzyl-alcohol system). One can even combine formic acid, acetic acid, monochloracetic acid, etc., with the wood.

The reactions of lignin with mercaptans, particularly thioglycollic acid, are of special importance. The mercaptans ($R-SH$) in common with the alcohols react with lignin in wood in the presence of mineral acids. If ethanol lignin is treated with thioglycollic acid the ethoxyl groups are exchanged for the $-S-CH_2-COOH$ groups. Owing to the greater ability of the mercaptan group to react with alcohols than the hydroxyl groups, the resultant thioglycollic acid-lignin products, by the treatment with more thioglycollic acid, particularly in the presence of hydrochloric acid, can take up an additional amount of thioglycollic acid. Thus thioglycollic acid reacts with alcohol with accompanying dehydration to form cinnamyl-thioglycollic acid: $C_6H_5CH = CH-CH_2-S-CH_2-COOH$. Tertiary butyl alcohol and α-phenetyl alcohol react similarly, and what is more important, so do the ethers from these alcohol, *e.g.*, α-ethoxyphenylethane. Freudenberg and his associates investigated the acid decomposition product from dehydrodi*iso*eugenol methyl ether, which is structurally analogous to α-ethoxyphenylethane, and found that it reacted in the same manner. The heterocyclic ring is here opened and the following sulphonation product is obtained:

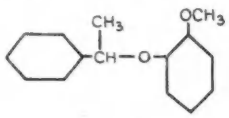


XXXI

In this particular case it should be noted that the reaction (ring opening) must be facilitated by the carboxyl group, which is in *para* position to the ring oxygen atom. α-Phenetyl guaiacol ether (XXXII) is split by methyl alcoholic HCl (to guaiacol and α-methoxyphenylethane) as well as by bisulphite and thioglycollic acid. These reactions seem, however, to proceed much slower than the corresponding reactions with lignin.

Actually it is surprising how much more easily sulphonation, the most important reaction of lignin, takes place with hardwood lignin than with the softwood type. It is possible for wood to be completely digested even at 50° if it is treated with sulphite cooking acid of very high SO_2 content (10-11 per cent. free, 1 per cent. bound). The "time of cooking" is naturally very long: 1000-1500 hours. It is worth noting that in this process hardly any carbohydrate breakdown occurs, but a "holocellulose" in a yield of up to 70 per cent. is obtained.

Investigations by Hägglund show that lignin contains groups with dissimilar ability to react. It is possible to sulphonate at a *p*H of about 7, or even slightly on the alkaline side. Rapid sulphonation only takes place, however, if the cooking fluid is acid. With low acidity the sulphonation soon ceases. Approximately one sulphonic acid group is introduced for every four lignin units (40 carbon atoms). The sulphonic acids thus obtained are not dissolved, or only dissolved with difficulty, in the early stages



XXXII

and are easily polymerised by acids. The sulphonation takes place quicker with higher acidity and leads to more stable soluble sulphonic acids containing approximately one sulphonic acid group per two lignin units (20 carbon atoms). That wood lignin is changed by treatment with acid or alkali, or even by prolonged heating in water or a buffer solution of *p*H 7, is revealed by the fact that wood pre-treated in this manner is more difficult to sulphonate and the sulphonic acids obtained are separated with greater difficulty. The same applies to lignin which is isolated from wood by treatment with concentrated hydrochloric acid. That this change is due to a hydration or condensation of lignin molecules, through reactive groups which would otherwise react with sulphite, appears evident. Sulphite cooking-acid is, as is well known, strongly acid, and in the digestion of wood there is consequently competition between the condensation reaction and the formation of sulphonic acids. The molecular size of the sulphonic acids and their sulphur contents vary consequently from sample to sample of liquor, according to the composition of the cooking-acid and the course of the cooking-curve.

A further complication is created by the circumstance that sulphite cooking-liquor has oxidising properties as well, which among other things is disclosed by Hägglund's important discovery that sugar from spent sulphite liquor can be oxidised to an aldonic acid. The chemistry of sulphite-cooking is, it appears, highly complicated and presents many problems as yet unsolved.

An extended investigation of sulphonic acids in residual liquors from varied sources is being carried out at the Central Laboratory, Stockholm. It covers, among other things, the so-called β-lignin-sulphonic acids which differ from the majority of sulphonic acids (α-acids) in that they are of relatively low molecular weight, rich in sulphur and, peculiarly enough, deficient in methoxyl groups.

The essential fact in the chemistry of sulphite-cooking is that the cooking-acid is sufficiently acid to attack the various groups in the lignin, inducing hydrolytic splitting of rings and ethers, and afterwards to react with the lignin to form stable, soluble sulphonic acids. Other lignin groups capable of sulphonation are, most probably, secondary and tertiary alcohol groups, as appears from Holmberg's experiments. That lignin contains groups of varying liability to sulphonation is shown by experiments made on the effect of phenols on the sulphite pulping reactions made in conjunction with a structural investigation of the substances in pine heartwood which inhibit the normal pulping reactions. It is possible to digest pine or fir heartwood in the presence of different phenols, if, as a first step, slightly acid cooking-liquor is used. By this means the groups in the lignin are sulphonated. On the other hand, if the cooking-liquor had been more acid it would have condensed preferentially with the phenols. If the acidity is increased other groups are sulphonated, and are unable to react with the phenols even with increased

acidity, and generally highly sulphonated, easily soluble, sulphonic acids are obtained, despite the presence of phenols.

Among the many reactions of lignin-sulphonic acids, that of the formation of vanillin by heating them with alkali is interesting. Through systematic variation of the alkali concentration and the period of heating, Tomlinson and Hibbert succeeded in more than doubling the previously indicated yield of vanillin, obtaining a 6-9 per cent. yield. The yield of vanillin is in direct proportion to the sulphur content of the lignin-sulphonic acids. This derivation of vanillin from the lignin-sulphonic acids in the sulphite liquor plays a certain role in connection with the well-known method of Howard: the isolation on a technical scale of lignin-sulphonic acids from sulphite liquor, through successive calcium precipitations; but this can now be said to be displaced by the above-mentioned catalytic oxidative methods (oxidation in alkaline solution with oxygen in the presence of metallic oxides). The lignin remaining after the production of vanillin, which in the Howard process is used for the manufacture of artificial resins, contains aromatic elements.

Thus a preparation of calcium lignin sulphonate was obtained containing 7.2 per cent. sulphur, 4 per cent. vanillin (calculated on Ca-free basis), and a lignin residue, which after digestion with alkali, according to Freudenberg, and methylation with dimethyl sulphate and with diazomethane and oxidation with potassium permanganate, gave 11.0 per cent. of veratric acid, 7.2 per cent. of *iso*hemipinic acid, and 2.9 per cent. of dehydrodiveratric acid (total 21.1 per cent.). If these figures are recalculated on the basis of the original lignin-sulphonic acid, one obtains 4.0 per cent. of vanillin, 8.4 per cent. of veratric acid, 3.7 per cent. of *iso*hemipinic acid and 1.5 per cent. of dehydrodiveratric acid (total 17.6 per cent.). The lignin residue thus gives proportionately more *iso*hemipinic acid and less veratric acid than does lignin sulphonic acid, which is to be expected, as part of the terminal groups containing veratric acid are already separated in the form of vanillin.

Much valuable knowledge on the subject of lignin chemistry has undoubtedly been gained during recent years, and everything seems to show that the essential structural element of the lignin is the phenylpropane unit. Test experiments show that the reactions of lignin have perfect analogies among phenyl-alkylcarbinols and their ethers. This puts lignin in the same class as the artificial resins with their mechanical properties and scientific difficulties.

Society of Glass Technology

Illumination Problems and Gas Producers Discussed

At the 25th annual general meeting of the Society of Glass Technology held at Sheffield last month, with the President, Dr. S. B. Bagley, in the chair, Dr. S. English, D.Sc., F.I.C., F.Inst.P., a former President of the Society of Illuminating Engineers, was elected president. Other officers: Vice-presidents: Miss A. M. Jackson and Mr. W. A. Moorshead; members of Council: Mr. H. E. Jones, Dr. J. H. Partridge, Dr. E. Seddon, Mr. Th. Teisen, and Mr. R. E. Threlfall; Hon. Treasurers: General, Mr. F. G. Orme, American, Mr. F. C. Flint; Hon. Secretary, Professor W. E. S. Turner.

Dr. English then gave his presidential address, on "The Commercial Use of Scientific Data," of which a summary follows. After a brief review of the rapid development of the science of glass technology during the past 25 years, and the importance of the results obtained in their application to manufacturing processes, the problems of illuminating glassware of the diffusing type were considered in detail.

The problem of glare was emphasised in relation to the adaptability of the human eye to an enormous range of illumination intensities from 2000 to 4000 ft.-candles on a bright summer day to 0.002 ft.-candles for A.R.P. lighting. Diffusing glass envelopes reduce the glare and increase the detail comprehended by the eye by removing the intensely bright source from direct vision.

The properties of completely diffusing opal glasses in conjunction with metal filament lamps were then described, and examples given of the use of physical data for the predetermination of the performance of various types of lighting fitting. The efficiency of an opal sphere as a lighting unit depended on (1) *Glass*: perfect sphere, uniform thickness, no neck opening, and perfect diffusion of transmitted and reflected light; (2) *Lamp*: a uniform light distribution.

Improvement in Gas Producers

After luncheon a paper on "The Utilisation of Low-Grade Fuel in Gas Producers" was given by M. W. Thring, B.A. Modern theories of the mechanism of gasification go considerably beyond the old "two-zone" picture, and in themselves offer considerable possibilities in the way of handling inconvenient fuels without inconvenient results. Until recently a gas producer was considered to operate by complete combustion of the air in the first few inches of the bed, followed by gradual reduction of CO_2 and H_2O in the next region. Steam was introduced to prevent clinker forming by lowering the maximum temperature, and to permit a certain degree of water-gas enrichment. The defects in operation all arose from distribution in the blast, allowing CO_2 to penetrate unreduced.

A study of the effect of nozzles in small gas producers showed that such nozzle raised the peak temperature in the bed, while at the same time improving the quality of the final gas. Such an effect is understandable only if the heat loss from the hottest part of the bed is regarded as having a decisive influence on the process of gasification. The nozzle reduces the heat loss and this in turn enables the reduction reaction to proceed faster. The fuel bed near the point of maximum temperature is in a critical state and everything must be done to reconvert the energy into chemical form before irreversible loss of energy by heat transfer can take place. Any lowering of the maximum temperature by reducing the consumption per square foot and water-cooling the walls is thus clearly bad from the point of view of obtaining the best gas.

Even the addition of steam for this purpose has a deleterious effect, since it has to be carried to such an extreme that it becomes a heat absorber and thus slows down the reduction reactions, with consequent deterioration of gas quality. This work showed further that an intense air blast directed into live fuel tends to keep uniform the packing of the particles in the bed, since the rapid fuel consumption, together with the mechanical action of the blast, leads to a loosening of the fuel particles.

It would seem from the above that relief from clinkering troubles could be achieved only at the expense of a marked lowering of gas quality, for all the methods of lowering the temperature also retard the reduction process. Further study has suggested a way of avoiding the horns of this dilemma, namely, by achieving an improvement in the gas quality at the point of maximum CO_2. It has been found experimentally that the peak CO_2 content and peak temperature (corrected for heat loss) are but little influenced by all factors other than the fuel size (dry producer). The smaller the fuel, the less the maximum CO_2 and the less the maximum temperature. This result becomes intelligible only if we consider that the consumption of oxygen takes place by two different reactions; one at the fuel surface in which CO and CO_2 are generated, and a second in the voids where CO burns to form CO_2. It is not improbable that a full appreciation of these facts may lead in future to improvements in the design of producers.

COLLECTED NOTES ON CHEMICAL SAFETY

Dangers in Handling Dyestuffs

by JOHN CREEVEY

DYESTUFFS, and certain of their intermediates, exhibit fire and explosion hazards which point to the need of particular care in manufacture, especially in drying and pulverising the dried cake. An investigation of numerous separate fires at works engaged in the manufacture of dyestuffs and intermediates (*Chem. Met. Eng.*, 1924, *30*, 388; *Chem. Tr. J.*, 1924, *74*, 373), taken from records of the National Fire Protection Association in the United States, has provided a useful analysis of processes and equipment involved, as well as products.

Heating Systems, Plant, and Products.

Out of ten fires occurring in course of drying the product, steam heat was involved in five cases, and fire heat in only two cases; this points to a general tendency to regard the steam heat as having much less risk, compared with fire heat, and a consequent slackening of safety measures and observance of conditions. In six cases out of the ten, wooden trays were in use. The products involved were dry colours (2), sulphanilic acid paste (2), alpha-naphthalene (1), azo-colours (2), alizarine brown R (1), and sulphur colours (2). Source of heat is not stated for two cases, but it is well to note that steam and fire were not alone responsible, for hot water was in use in one instance. The equipment was known to be made of metal or some other non-combustible material in six cases out of the ten, considered apart from the use of the wooden trays already mentioned.

For 21 cases of fire arising while pulverising the product, there was no information as to type of mill in seven cases; of the remainder, barrel or ball mills were in use in eight cases and high-speed grinding plant in six cases. It is to be noted that two of the ball mills were provided with bronze balls as grinding medium; in the other six, the usual pebbles were in use. The products involved were alizarol yellow G (3), alizarol brown RB (3), chrome yellow (2), and one case each for benzidine, mordant chrome, CGX yellow, sulphur green T, methylene green B, yellow R, hexamethylene tetramine, chrome black, a brown colour and an azo dye, with no indication given in three cases.

Kettles, pans, autoclaves and similar vessels had either fire heat (30), steam heat (7), or hot oil in circulation (5); emphasis is laid again on the risks still involved where steam heat is used. For the 30 fire-heated vessels, the more detailed cause was: rupture under pressure (6), overflow or leakage reaching the fire (11), overflow of oil from an oil-jacket (3), ignition of escaping vapour by flame from the fire (3), troubles due to the furnace setting or the fuel itself (4), and ignition of "the contents of the kettle" (3). With circulation of hot oil the trouble started with leakage of hot oil or with overflow of oil from the expansion tank reaching the fire in the heating furnace. Both these instances were confined to an accessory part of the plant, namely, the room in which the circulating oil was heated.

A general consideration of the products reveals that either drying or pulverising of colours was involved in about one case of fire in four. Of the intermediates and basic starting points in dyestuff manufacture, the most frequently occurring were aniline (10), benzol (10), nitrobenzol (9), naphthalene (8), toluol (6), phenol (6), nitrotoluols (5), naphthol (4), alcohols (4), followed by chlorbenzol, phthalic acid, nitrochlorbenzol, picric acid, anthraquinone, carbone disulphide, benzanthrone, dimethyl *ortho*-toluidine, naphthylamine, nitrophenol, *para*-phenylene diamine, and picramic acid.

Accessory Causes of Fire or Explosion.

Plant engaged in the manufacture of dyestuffs is no more immune than other chemical plant from such sources of trouble as leakage from a broken gauge glass (which was unprotected) on a storage tank containing inflammable liquid, leakage of an inflammable liquid from pipe joints or pump gland while being moved from vessel to vessel by a pump, and ignition of inflammable vapour by sparks from an unprotected motor, switches, or frayed electric light cable. Continuous attention to the possible arising of such matters as these, involving maintenance routine, is equally desirable for all chemical plant.

Recovery of Solvent by Vacuum Stove.

An explosion during the recovery of benzene and acetone from smokeless powder by means of a vacuum stove (*Insp. Expl. Rep.*, 1920, No. 238) may profitably be recalled in the matter of dyestuff drying because of the contributory factors suggested as being involved. This stove was fitted with hollow iron shelves in which steam circulated and which supported asbestos cement trays, with wood rims, on which the smokeless powder was placed. Vacuum as well as heat was utilised in recovering the solvent vapours. When the vacuum reached a certain height, air was admitted so that the doors of the stove could be opened and the trays removed; it was during this operation that an explosion occurred. The initial flash appears to have been caused by the friction between one of the trays and some dry nitrocellulose dust on the warm iron shelf. An explosion in like circumstances might well take place in the drying of a dyestuff which is hazardous. A repetition of the accident here cited would be avoided if steam as well as air was admitted to the stove to break the vacuum, thus making conditions humid for any dry dust on the iron shelves. Other recommendations included the provision of a door at the back of the stove so that the interior could be more effectively cleaned; that the load on the trays be lightened to reduce friction; and that brass wheels or rollers be fitted at the rear of the trays for the same purpose of reducing friction in the act of withdrawing them.

Dinitrophenol and its Sodium Salts.

By an Order in Council dated June 27, 1927, dinitrophenol was declared to be an explosive within the meaning of the Explosives Act, 1875, unless it contains water in the proportion of not less than 15 per cent. by weight, or, if less water is present, the product is packed in sealed packages in the construction of which—except for nails—no metal other than aluminium or a 90 per cent. aluminium alloy is used. This Order followed an explosion in a hydro-extractor which was handling sodium dinitrophenate paste (*Chem. Tr. J.*, 1926, *15*, 522), when two persons were killed and several others injured; tests applied to the paste failed to show any risk of fire, yet the explosion was followed by a fire. The dinitrophenates, as well as mixtures of dinitrophenol with other substances, are regarded as explosives unless (a) for dinitrophenates there is not less than 33 per cent. by weight of water present and packages for storage or transport are such that evaporation is prevented, or (b) dinitrophenol has mixed with it not less than three times its weight of anhydrous sodium sulphate, or the equivalent of crystallised sodium sulphate or potash alum.

Drying and Pulverising Dyestuffs.

As far back as 1919, at the 8th Annual Safety Congress of the National Safety Council in the United States, it was emphasised that "the greatest hazard of the dyestuffs industry, at least from the standpoint of the severity of results, is the explosion risk." Explosions may occur with dyestuffs *or* their intermediates. Actual dyestuffs, considered apart from intermediates, should always be tested to ascertain whether they are of explosive nature, before any attempt is made to dry or pulverise the dried cake in large quantities; indeed, in doubtful cases it is well to examine this risk periodically, batch by batch in manufacture, because a slight difference of quality for an intermediate or a slight variation in the processing conditions can give rise to certain unstable conditions for final treatment. It is needful to be especially critical of dyestuffs that are to be handled in dry powder form, unless their chemical constitution shows that they are well provided with sulphonic acid groups.

Personal Notes

MISS CATHERINE MUNRO, chargewoman at a powder factory of Imperial Chemical Industries, Ltd., has been awarded the British Empire Medal.

MR. CYRIL JAMES WHITELEGG, B.Sc., M.Sc., A.I.C., Research Assistant to the Chief Chemist, Bleachers Association, Ltd., Manchester, has been elected a Fellow of the Textile Institute.

MR. B. P. HILL has been elected chairman of the Newcastle Section of the Society of Chemical Industry, in succession to DR. A. A. HALL. MR. P. L. ROBINSON is vice-chairman.

MR. HUGH N. LINSTEAD, secretary of the Pharmaceutical Society of Great Britain, has been elected M.P. for Putney by a majority of 5849 over his Independent opponent. Mr. Linstead stood as a National Government candidate.

DR. S. S. JOSHI (Hindu University, Benares) has been elected president of the Chemistry Section, and PROFESSOR K. ASTON (Indian Institute of Science, Bangalore), president of the Engineering and Metallurgy Section of the Indian Science Congress which is to be held in Lucknow from January 2 to January 8, 1943.

DR. C. G. DARWIN, M.C., F.R.S., director of the National Physical Laboratory, has been appointed Scientific Adviser to the Army Council. The Minister of Supply is appointing Dr. Darwin to be a member of the Scientific Council of the Ministry in addition. Dr. Darwin, it will be remembered, was last year appointed director of a Central Scientific Office, working under the direction of the British Supply Council in North America, so that his brilliant scientific achievements are supplemented by a wide practical knowledge of the supply problems created by the war

DR. HUGH S. TAYLOR, David B. Jones Professor of Chemistry and Chairman of the Department of Chemistry at Princeton University, has been awarded the Longstaff Medal by the Chemical Society of London. The medal is conferred every three years on that Fellow of the Chemical Society "who, in the opinion of the Council, has done most to promote the science of chemistry by research." Dr. Taylor is a member of a family well known in St. Helens, Lancs., for its scholastic attainments. Two of his sisters teach at the Notre Dame Convent there, one being head mistress, one of his brothers is head of a Grammar School in Lancashire, and yet another is on the professional staff at Princeton.

MR. W. T. HALCROW, who delivered the 32nd annual May Lecture before the Institute of Metals ("Water Power and its Application to the Production of Metals") on Wednesday, is senior partner in the firm of W. H. Halcrow and Partners (successors to P. W. and C. S. Meik). He was at one time engaged on the Kinlochleven hydro-electric works and on the death of his partner, Mr. C. S. Meik, carried out the Lochaber Water Power undertaking. He is consulting engineer for the Caledonian and the Grampian Water Power developments. Mr. Halcrow has had many years' experience of dock, harbour, and railway work at home and abroad, and among his many appointments he includes those of Joint Engineer to the Ministry of Home Security for deep-level tunnel shelters, and Member of the Council of the Institution of Civil Engineers.

Obituary

MR. ALFRED GLADSTONE WATERHOUSE, J.P., who died on May 9 at Pendleton, Manchester, aged 72, after a long illness, was a director of Peter Spence and Sons, Ltd. Mr. Waterhouse entered the service of the firm in 1885. He succeeded as chief of the travelling staff, and was made a director in 1929. Appointed J.P. as Magistrate on the Salford Bench in 1924, he served also on the Licensing Committee and as Land Tax Commissioner for the County of Lancaster. He was a member of the Booth Charity, and was a prominent supporter of the Charlestown Congregational Church.

New Control Orders

Coal Tar Bases and Road Tar

BY the General Licence (Disposals) No. 1, dated May 1 (S.R. & O. 1942, No. 286), the Secretary for Mines licences any distiller or importer to dispose of coal tar bases, *i.e.*, the constituents, whether crude or refined, of coal tar which are obtainable from the distillates from coal tar and are extractable by, and soluble in, dilute mineral acid. This definition includes pyridine and all higher-boiling homologues of the pyridine series.

The Road Tar Prices (Inland) Order, 1942, General Direction, No. 1 (S.R. & O. 1942, No. 825) directs that when road tar contains a percentage of bitumen not exceeding 5 per cent., the price per gallon may be increased by ½d.; when the percentage of bitumen exceeds 5 per cent., but does not exceed 10 per cent., the price may be increased by 1d. per gallon. The Direction is dated May 1.

Soya Flour

By the Soya Flour (Control and Maximum Prices) Order, 1942 (S.R. & O. 1942, No. 863), which came into force on May 11, the manufacture and prepacking of soya flour are subjected to licence by the Ministry of Food. The maximum price of soya flour, not being prepacked, is £33 5s. per ton, including the weight of the immediate container. For prepacked soya flour the maximum price of 8s. per dozen containers, each containing 1 lb. net weight, is prescribed, with adjustments for wholesale and retail transactions.

Quality Control Charts

Useful B.S.I. Publication

THE meeting to arouse interest in the application of statistical control of the quality of materials and manufactured products, held last month under the ægis of the Institutions of Civil, Mechanical, and Electrical Engineers with the support of the Engineering Advisory Committee of the War Cabinet (and reviewed in our current leading article), has focussed attention on two publications issued by the British Standards Institution. The first of these, B.S. 600 R., entitled Quality Control Charts, deals comprehensively with the construction and use of control charts and gives enough of the underlying statistical theory to enable the production engineer to appreciate the significance of the instructions given for the use of the charts.

A full understanding of these underlying principles, while obviously an advantage, is not absolutely essential before making a start in the practical application of statistical methods of quality control. For those who desire to put the methods into practice without bothering about the statistical theory, concise instructions are given in B.S. 1008, "Guide for Quality Control and Control Chart Method of Analysing Data." The publication is a reproduction of an American Defence Emergency Standard, and it is of interest to note from the foreword that it was originally drafted at the request of the U.S.A. War Department with a view to assisting in the speeding up of armament production. Generally speaking, quality control by the methods described in these two publications is applicable to any case of manufacture in which limits must be worked to and which has as a feature large production, continuous flow, or batches of considerable size.

A study of either or both of the publications, B.S. 600 R. and B.S. 1008, has been recommended to all production engineers by the Regional Boards of the Ministry of Production. To those who have had an opportunity of seeing advance proofs of B.S. 600 R. it is desired to point out that certain errors had not been corrected, and a copy of the document as finally published should, therefore, be obtained. Copies of both these British Standards may be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1, price 3s. 6d. each (3s. 10d. post free).

General News——From Week to Week

Three factories for production of industrial alcohol from potatoes recently began operations in Ireland. It is reported that approximately 4000 tons of potatoes will be available annually for these plants.

The United Kingdom Naval Stores Association, Ltd., 106 Fenchurch Street, London, E.C.3, has been appointed as agent of the Ministry of Supply for the distribution of imported terpineol. Sales will be made to approved users for pharmaceutical purposes only. Until further notice the price will be 2s. 6d. per lb., ex store, in original containers.

The British Standards Institution has received a communication from the Minister of Production to the effect that H.M. Government recognises the Institution as the sole organisation for the issue, in consultation with any Government, professional, or industrial bodies concerned, of standards having a national application.

The B.D.H. list of alterations in prices of laboratory chemicals, dated May 1, is the third issued since the catalogue was last published in November, 1940, and cancels earlier issues. It is to be noted that all prices are without engagement. Economy in the use of all laboratory chemicals is essential and a number (here listed) are either no longer available or in very short supply.

Imperial Chemical Industries regret that, owing to the exigencies of war, they are no longer able to supply " Cellofas " in foodstuffs quality. The normal technical grade is still available and is suitable for a large variety of technical purposes. This grade, however, is not guaranteed to conform with the Food and Drugs Act, nor is it guaranteed to contain less than 20 parts per million of lead, arsenic, copper and zinc inclusive. Only one viscosity, medium viscosity, is being sold in future.

The conference of the National Union of Dyers, Bleachers and Textile Workers, at its concluding session at Blackpool on May 12, decided to take the claim made to the Allied Association of Dyeing and Finishing Trade Employers for an increase of 5s. a week for men and corresponding increases for other grades before the National Arbitration Tribunal. The conference decided to give one month's notice to terminate the agreement with the employers, to be followed by one week's notice to terminate employment unless a settlement is reached.

It is most important that traders should familiarise themselves with the Government insurance schemes which exist for their protection. They can do so by consulting the insurance company, broker or agent through whom they effect their ordinary fire insurance. The Commodities Scheme, covering traders' stocks, and the Business scheme, covering plant and machinery and business equipment generally, are both compulsory, where the value of the insurable stocks or equipment exceeds £1000. To assist small traders, particularly in the salvaging of their stocks, the Board of Trade are encouraging the establishment of Mutual Aid Associations to act in close co-operation with the District Insurance Committees, 35 of which cover the United Kingdom.

Foreign News

Germany's latest fully-synthetic fibre, " Perlon," will soon be in large-scale production, according to *Vierjahresplan*. It will be used at first for shoe laces, for toes and heels of socks and stockings, and for other hard-wearing textile purposes.

The annual report of the Indian Lac Cess Committee, Ranchi, Bihar, India, for the year ended March 31, 1941, has just been published. Production for the year, at 1,233,375 maunds, and exports, at 808,877 maunds, are both lower than in any of the previous four-yearly periods.

Production of crude sulphur in the United States in 1941 attained a new record of 3,139,253 long tons, a 15 per cent. gain over the 1940 output, according to the United States Bureau of Mines. Mine shipments increased by one third and were also the largest on record—3,401,410 long tons valued at $54,400,000, compared with 2,558,742 tons valued at $40,900,000 in 1940.

Italian mercury sales have declined, reports Monte Amiata, the leading producer, as nearly all export customers, apart from Germany, have been lost. The net profit advanced in 1941 from 12.3 to 15.0 million lire.

Demand in Uruguay for carbon tetrachloride, prior to 1939, was comparatively small. With its adoption in the preparation of remedies to combat worm maladies of sheep, imports increased considerably to 190,400 lb. in 1940, from 99,600 lb. in 1939. Imports in 1941 were up 25 per cent.

Sulphuric acid and copper sulphate are to be manufactured at Zagreb, Yugoslavia, by Chemical Factories, Ltd., a newly-formed company, which has received monopoly rights from the Nazi authorities in this field of chemical manufacture, in return for an obligation to erect works within the next two years. The company will also make superphosphates.

As a result of an investigation of a means of eradicating the water hyacinth, Mr. M. A. Azam, of the Industrial Research Laboratory, Department of Industries, Government of Bengal, has devised means for the utilisation of water hyacinth in the manufacture of paper and pressed boards. A process of preparing pulp from the plant has been worked out, which, it is stated, may be followed on a cottage scale in the villages of Bengal.

It is understood that the U.S. Government has undertaken to buy the surplus of the rubber produced in Amazonas, Brazil, during the next five years, and that an organisation is being formed in order to develop Brazilian rubber production and exports to the U.S.A. Brazil's rubber production averages about 20,000 metric tons per annum, of which about 12,000 tons are exported, but it is estimated that, if current labour and transport difficulties were overcome, the yearly output could be raised to well over 30,000 tons.

The Ceará magnesite deposits in northern Brazil are reputedly capable of supplying, for export, about 150 metric tons of calcined magnesite monthly, and with a small amount of additional work this could be increased to about 1000 monthly. Magnesite from these deposits is said to analyse from 47.3 to 47.5 per cent. MgO, 0.4 to 0.5 per cent. silica, and 0.5 to 0.8 per cent. oxides of aluminium and iron, and the deposits are now supplying S. Paulo and Rio de Janeiro with the mineral.

Shortage of raw materials is seriously interfering with the chemical industries of Mexico. Among urgent requirements recently listed are included cyanides, coal-tar dyes, olive oil, essential oils, cocoa butter, citric and tartaric acids, and ammonium sulphate. The soap and oils industry is further hampered by a shortage of sodium hydroxide, while lack of linseed oil, dyes, varnishes, hydrochloric and sulphuric acids, alum, chromium, potassium bichromate, sodium bichromate, and tanning extracts is affecting the tanning industry.

Forthcoming Events

There will be a joint meeting of the **Road and Building Materials Group** of the Society of Chemical Industry, with the **Institution of Municipal Engineers,** on **May 19,** at 5 p.m., at Gas Industries House, Grosvenor Place, S.W.1. A paper on " Performance Tests for Road Tars " will be presented by Mr. G. H. Fuidge and Mr. J. G. Mitchell.

The twenty-third annual general meeting of the **Chemical Engineering Group** of the Society of Chemical Industry will be held at the Waldorf Hotel, Aldwych, London, W.C.2, on **May 20,** at 12.30 p.m., preceded by a meeting of the general committee at 12 noon.

" The Future of the Milk Industry " is the title of the paper to be presented by Professor H. D. Kay (Director of the National Institute for Research in Dairying), at a meeting of the **Royal Society of Arts,** to be held at 1.45 p.m. on **May 20,** at John Adam Street, Adelphi, W.C.2.

The Chemical Society announces that the Tilden Lecture, entitled " The Chemistry of the Lignan Group of Natural Products," will be given by Professor R. D. Haworth, in the Rooms of the Society at Burlington House, W.1, on **May 21,** at 4.30 p.m.

New Companies Registered

Chemo-Plastics, Limited. (373,751).—Private company. Capital: £1000 in £1 shares. Manufacturers, exporters and importers of, factors and agents for and wholesale and retail dealers in plastics and articles made therefrom, chemicals, drugs, proprietary articles, and laboratory equipment, etc. Solicitors: Shapiro, Kaufman & Co., 21 Buckland Cres. N.W.3.

Company News

British Drug Houses, Ltd., report a dividend of 2 per cent. for 1941 (6 per cent.).

Cooper, McDougall and Robertson, Ltd., report a trading profit, for the year ended September 30, 1941, of £204,286 (£115,647). A dividend of 5 per cent. has already been paid.

The Rio Tinto Company report a total revenue for 1941 of £494,117 (£769,881), and announce that the preference dividend for the year will be paid in full.

High Duty Paints, Ltd., Home Farm Works, Buckingham, have increased their nominal capital beyond the registered capital of £100, by the addition of £400 in £1 ordinary shares.

Stewarts and Lloyds, Ltd., report a net profit for 1941 of £1,008,361 (£918,942, increased to £1,004,696 by writing back the balance of reserve against expenditure on air-raid precautions no longer required). Dividend payments appeared in our issue for April 11.

Babcock and Wilcox, Ltd., announce in a preliminary statement, that the profit for 1941 amounted to £616,021 (£717,347). They have declared a final dividend of 6 per cent., together with a bonus of 1 per cent. on the ordinary stock, again making 11 per cent. for the year.

The Central Provinces Manganese Ore Company, whose profits for 1941 amount to £566,538 (£568,199), are paying a tax-free dividend of 22½ per cent. (same). The directors have announced the payment of a final of 1s. 6d. per share, making 2s. 3d. net for the year on the 10s. units.

Chemical and Allied Stocks and Shares

SENTIMENT in the stock and share markets improved earlier in the week under the influence of the Prime Minister's speech, and more encouraging views of war developments. Dealings were somewhat more active, and values in most sections have improved at the time of writing, although attention centred mainly on British Government and kindred securities. Shares of chemical and allied companies benefited from the general tendency, and Imperial Chemical at 33s. 9d. were again higher on balance for the week, awaiting the chairman's annual review. I.C.I. 7 per cent. preference were active, and were quoted at 35s. 3d. B. Laporte remained at 63s. 9d., pending the dividend announcement, and the 10s. ordinary shares of Goodlass Wall, whose results are also due shortly, were again quoted at 8s. 9d. Turner and Newall had a firm appearance at 66s. 9d.

Elsewhere there was further improvement in Dunlop Rubber to 27s. 3d., at the time of writing, more hopeful views having developed in the market regarding the forthcoming dividend announcement. Rather more attention was given to Imperial Smelting shares, which were higher at 9s. 6d., while General Refractories held their recent improvement to 9s. 1½d. Moreover, Lever and Unilever participated in the better tendency, being slightly higher on balance at 25s. 3d. British Match remained under the influence of satisfaction with the results, and at 33s. 6d. were higher on the week, while Borax Consolidated held their recent rally to 31s. An improved price of 67s. 3d. has been made by British Oxygen at the time of writing, and British Aluminium have had a firm appearance at 43s. 3d.

Fison Packard were again 38s. 9d., awaiting the interim dividend, which it is being assumed will be the same as a year ago. Cooper McDougall were again quoted at 23s. 9d., and Lawes Chemical 10s. ordinary were around 8s. 9d. As usual, William Blythe 3s. shares were firmly held, and were quoted at 6s. 3d. Business at 5s. 9d. was recorded in Blythe Colour 4s. ordinary, and at around 18s. 9d. in Forster's Glass 10s. ordinary. Results of the last-named company fall to be issued next month. A good deal of attention continued to be given to securities of companies identified with plastics. British Industrial Plastics 2s. ordinary transferred around 4s. 1½d., Lacrinoid Products 2s. ordinary around 3s., and Catalin 5s. shares changed hands at 2s. 9d. Erinoid 5s. ordinary were dealt in up to 8s. 4½d.

Iron and steel issues were inclined to improve, sentiment being aided by the further indication of expanding operations provided by the annual report of Stewarts and Lloyds. The deferred units of the last-named company were 45s. 3d., while Tube Investments were 81s. 6d., but the latter quotation was "ex" the interim dividend. Although "ex" the final payment, Babcock and Wilcox were 43s. 4½d., and were inclined to improve. Staveley shares were 44s. 3d., and Allied Ironfounders 24s. Results of the Pressed Steel Co. and Colvilles were also favourably received in the market; the shares of both companies were firm.

There was again a fair amount of activity in British Plaster Board shares, which were around 20s. 3d. United Molasses have gone back from 29s. to 28s. 3d., but are now "ex" the dividend. The units of the Distillers Co. eased a few pence to 74s. 3d. At 26s. 10½d. Barry and Staines were unchanged on balance, awaiting the financial results, while Nairn and Greenwich were 51s. 3d. On the other hand, Wall Paper Manufacturers deferred units eased, following their recent advance, and were 23s. 9d., compared with 24s. 9d. a week ago. There was again rather more business in Morgan Crucible 5½ per cent. preference shares, dealings being recorded up to 26s. 3d. Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. Among other securities, Boots Drug had a firmer appearance at 32s. 9d., and British Drug Houses were 26s. 3d., awaiting the results. Timothy Whites were 20s. 3d., and Sangers 15s. 9d. Textile issues were without feature, apart from further activity in Fine Cotton Spinners. Small gains were recorded among leading oil shares.

British Chemical Prices

Market Reports

THE general chemicals market throughout displays an even tone and a steady volume of new business is reported, while the renewed export inquiry recorded last week has been maintained. In the potash section supplies of yellow prussiate are limited, and there is a ready market for caustic potash, permanganate, and bichromate of potash. The demand for the soda products continues on a good scale, with offers of chlorate and bichromate scarce. Buying of oxalic, tartaric, and citric acids continues to be measured by the quantity available, while the demand for acetic acid remains strong. Trade in the coal tar products market has been on a moderate scale during the past week, and, with an increasing number of sections coming within the scope of official control, the tendency is for unrestricted trading to become the exception rather than the rule. Deliveries of crude carbolic acid and cresylic acid against contracts are reported to be good and offers of naphthalene are quickly absorbed. Xylol continues quiet.

MANCHESTER.—Quotations on the Manchester chemical market during the past week have been on a steady to firm basis in practically all sections, and the tendency in several cases seems to be towards a further stiffening. In the meantime, the alkalis and most of the other bread-and-butter lines are being called for in steady quantities against contracts, with a moderate volume of fresh business for home consumption account transacted during the past few days. The by-products, with the possible exception of xylol and solvent naphtha, are a firm market and both the light and heavy materials are mostly in good demand.

GLASGOW.—Business in the Scottish heavy chemical trade has maintained its steady day-to-day transactions during the past week for home trade. Export business was rather quieter. Prices continued very firm at previous figures.

Price Changes

Ammonium Carbonate.—£37 10s. per ton d/d in 5 cwt. casks.

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Lead Nitrate.—About £47 per ton d/d in casks.

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Synthetic petrol, produced in Uruguay by a new process with local materials, has given satisfactory results in planes and cars, reports Reuter, and President Baldomir has instructed the Fuel Department to make official tests.

The island of Larak, near the mouth of the Persian Gulf, is recorded as a new source of red oxide of iron, though the quantity and quality of the material available are not as yet described. Deposits on the neighbouring island of Hormuz yield about 150 tons daily, varying between 60 and 90 per cent. Fe_2O_3.

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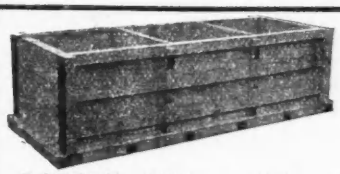

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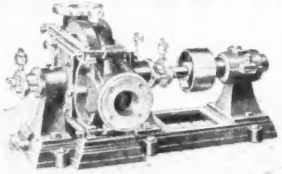

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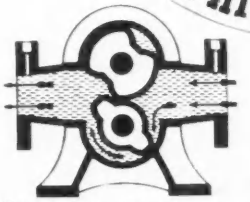

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Printed in Great Britain by The Press at Coombelands Ltd., London and Addlestone, and published by Benn Brothers, Ltd., at Bouverie House, 154, Fleet Street, E.C. 4. May 16th, 1942. Entered as Second Class Matter at the New York, U.S.A., Post Office.